means coupled in a signal path between a transmitting location and a receiving location for reducing echo errors and means in said signal path for providing decorrelation of signals in separate corresponding plurality of channels by providing an all-pass filter having different time varying filtering parameter in each channel wherein said time varying filtering parameter takes a bounded random variable.

Cancel Claim 11 without prejudice.

12. The system of Claim 10 wherein said bounded random variable has bounded values based on data for just noticable time delay difference from psychoacoustics.

REMARKS

A copy of the amendments is provided in the attached Appendix A to show the changes to the claims. Remove material is in brackets[] and added material is underlined.

Claims 6 through 13 are rejected under 35 U.S.C.112, second paragraph as being indefinite. It was pointed out the lack of clear antecedents in Claims 6 thru 11. It is believed that by the amendments to Claims 6,8,10 and 11 these objections are overcome.

It is believed that by these amendments the specification is corrected as required.

Claims 2-4,7-9 and 11-13 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as enable one skilled in the art to which it pertains, or with which it is most nearly connected to make and use the invention. More particularly the rejection is that the specification fails to explain the limitation "bounded random walk" in Claims 2,7 and 11.

The bounded random walk refers to the bounded random variable $\alpha_i(n)$ on page 11 and defined in equation 4. The term "bounded random variable" is used in the amended claims and the specification is amended to refer the bounded random variable $\alpha_i(n)$ and equation 4.

It is believed therefore that by these amendments the rejection under 35 U.S.C. 112, first paragraph is overcome.

Claims 10 through 13 are rejected under 35 U.S.C. 102 (b) as being anticipated by Peters U.S. Patent No. 4,063,034 (hereinafter Peters).

Applicant's amended Claim 10 calls for:

"A multi-channel acoustic cancellation system comprising:
means coupled in a signal path between a transmitting location and a receiving location for reducing echo errors and means in said signal path for providing decorrelation of signals in separate corresponding plurality of channels by providing an all-pass filter having different time varying filtering parameter in each channel wherein said time varying filtering parameter takes a bounded random variable."

Peters does not show a time varying filtering parameter that takes a random variable as claimed. Peters does not in any way suggest a random variable or a bounded random variable. The filter 36 is a transversal filter with a time delay T1 for the first delayed audio signal at tap 41preferably at a delay interval of 30 msec. The delay T2 for the second delayed signal is at twice the delay interval. There is no such time varying filtering parameter that takes a bounded random variable to provide decorrelation of signals.

Claims 1,5,6 and 10 are rejected under 35 U.S.C. 102 (b) as being anticipated by Shimauchi et al. U.S. Patent no. 5,661,813; herein after Shimauchi.

Applicant's amended Claim 1 calls for:

"In a communication system having a plurality of microphones at a transmitting location transmitting over separate corresponding plurality of channels to corresponding speakers in a receiving location and a plurality of microphones at the receiving location coupled over corresponding plurality of channels to speakers at the transmitting location generating echo signals, a multi-channel acoustic cancellation system comprising:

filter means coupled to output of said plurality of microphones at said transmitting location and input to said plurality of speakers at receiving location for providing estimated signals representing estimates of echo path responses from said plurality microphones from said receiving location to said plurality of speakers at said transmitting location;

means coupled to input of said plurality of speakers at said transmitting location and output of said microphones at said receiving location for providing true signals representing true echo signal;

means for subtracting said true signals from said estimated signals to reduce echo signals and to obtain coefficient control signals representing errors;

means for coupling said coefficient control signals to said filter means to change the filter coefficients to minimize said errors; and

means for providing decorrelation of said signals using all-pass filters in said channels having different time varying filtering parameter; said time varying filtering parameter being a bounded random variable."

Shimauchi reference describes a method for multi-acoustic echo cancellation. Shimauchi does not teach or suggest a means for decorrelation using a time varying filtering or a time

varying filtering having a bounded random variable. It is not seen where part 24 provides such decorrelation. In Shimauchi the cross–correlation variation adding part 24, the received signals of the respective channels are converted by being actively added with the variation in their cross-correlation. Based on how the time varying parameters are chosen, the cross-correlation variation may or may not result in decorrelation. Thus Shimauchi does not teach how to achieve decorrelation using a time varying filtering. Claim 1 provides this choice of time varying parameter as a bounded random variable to achieve decorrelation in the systems described. Claim 1 is therefore allowable over the Shimauchi reference.

Claims 3 thru 5 dependent on Claim1 are deemed allowable for at east the same reasons as Claim 1. Claim3 further calls for "wherein said bounded random variable has bounded values based on data for just noticable time delay difference from psychoacoustics." It is not seen where this is tought or suggested in Shimauchi. Claim4 further calls for the noticeable delay is between 30 and 200 microseconds. Claim 5 further calls for the filter means to include impulse response (FIR) filters that have filter coefficients updated adaptively depending on the input signals to the loudspeakers and outputs of the microphones.

Claim 6 calls for "means for providing decorrelation of said signals in said separate corresponding plurality of channels by providing an all-pass filter having different time varying filtering parameter in each channel wherein said time varying filtering parameter takes a bounded random variable." As discussed above this is not found Shimauchi.

Claim 10 calls for "means in said signal path for providing decorrelation of [said] signals in [said] separate corresponding plurality of channels by providing an all-pass filter having different time varying filtering parameter in each channel wherein said time varying filtering parameter takes a bounded random variable." As discussed above this is not found Shimauchi.

Claim 2 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Shimauchi. Claim 2 is incorporated into Claim 1 with the term bounded random variable. As discussed above the Shimauchi does not in any way suggest time varying filter for providing decorrelation or a bounded random variable filtering for decorrelation. It is therefore not seen how this filtering would be obvious in view of Shimauchi.

Claims 3,8 and 13 are deemed allowable for at least the same reasons as Claims 1,6 and 10 respectively and further for the bounded random variable values based on data for just noticable time delay difference from psychoacoustics. There is no such suggestion of this in the references.

Claims 4, 9 and 13 are deemed allowable for the same reasons the claims they depend on are allowable. These claims are further deemed allowable becasue they call for the noticeable delay is between 30 and 200 microseconds. This is not taught in the references.

In view of the above a notice of allowance of Claims 1,3-6,8-10 and 12-13 is respectfully requested.

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APPENDIX A

Pages 11 and 12, beginning on page 11, line 12 ; last partial paragraph change to :

" $\alpha_{i.max}$ and $\alpha_{i.min}$ in equation (4), represent the maximum and minimum allowable values of α_i (n) or the bounded random variable. In order to ensure stability, we must have $\alpha_{i.max} < 1$ and $\alpha_{i.min} > -1$. Further restrictions are also required to maintain transparency in speech perception. These restrictions are derived from the data known as "just noticeable inter-aural delay" in psychoacoustics. A discussion of this is found in E. Zwicker and H. Fastl, *Psychoacoustics: Facts and Models*, Heidelberg, Germany: Springer-Verlag, 1990. This data represents the minimum change in the inter-aural time delay between the two ears at a given frequency that causes a noticeable change in the perception of the direction of sound. The all-pass filter changes the phase of each frequency of the input speech. The effect of this phase change is to change the time arrival of the signal at each frequency in the ears. So, if we limit the phase changes so that the change in the time of arrival for each channel is within the just noticeable inter-aural delay, then spatial perception of stero signal will not be affected. The just noticeable inter-aural delay varies between 30 μsec. [To] to 200 μsec. We have chosen to limit the change in the time of arrival of each frequency within 60 μsec. This leads to the following values of $\alpha_{i.max}$ and $\alpha_{i.min}$,

$$\alpha_{i.max} = 0 \text{ and}$$
$$\alpha_{i.min} = -0.9. \text{"}$$

1. (amended) "In a communication system having a plurality of microphones at a transmitting location transmitting over separate corresponding plurality of channels to corresponding speakers in a receiving location and a plurality of microphones at the receiving location coupled over corresponding plurality of channels to speakers at the transmitting location generating echo signals, a multi-channel acoustic cancellation system comprising:

filter means coupled to output of said plurality of microphones at said transmitting location and input to said plurality of speakers at receiving location for providing estimated signals representing estimates of echo path responses from said plurality microphones from said receiving location to said plurality of speakers at said transmitting location;

means coupled to input of said plurality of speakers at said transmitting location and output of said microphones at said receiving location for providing true signals representing true echo signal;

means for subtracting said true signals from said estimated signals to reduce echo signals and to obtain coefficient control signals representing errors;

means for coupling said coefficient control signals to said filter means to change the filter coefficients to minimize said errors; and

means for providing decorrelation of said signals using all-pass filters in said channels having different time varying filtering parameter; said time varying filtering parameter being a bounded random variable.

3.(amended) The system of Claim [2] 1 [where the bounds in the value are] wherein said bounded random variable has bounded values based on data for just noticable time delay difference from psychoacoustics.

6.(amended) A multi-channel acoustic cancellation system comprising:

filter means coupled to output of [said] a plurality of microphones at a transmitting location and input to a plurality of speakers at a receiving location for providing estimated signals representing estimates of echo path responses from a [said] plurality microphones from said receiving location to [said] a plurality of speakers at said transmitting location;

means coupled to input of [a] said plurality of speakers at said transmitting location and output of [a] said plurality of microphones at said receiving location for providing true signals representing true echo signal;

means for subtracting said true signals from said estimated signals to reduce echo signals and to obtain coefficient control signals representing errors;

means for coupling said coefficient control signals to said filter means to change the filter coefficients to minimize said errors; and

means for providing decorrelation of said signals in said separate corresponding plurality of channels by providing an all-pass filter having different time varying filtering parameter in each channel wherein said time varying filtering parameter takes a bounded random variable.

8.(amended) The system of Claim [7] 6 [where the bounds in the value are] wherein said bounded random variable has bounded values based on data for just noticable time delay difference from psychoacoustics

10. (amended) A multi-channel acoustic cancellation system comprising:

means coupled in[said] a signal path between [said] a transmitting location and [said] a receiving location for reducing echo errors and means in said signal path for providing decorrelation of [said] signals in [said] separate corresponding plurality of channels by providing an all-pass filter having different time varying filtering parameter in each channel wherein said time varying filtering parameter takes a bounded random variable.

12. The system of Claim [11] 10 [where the bounds in the value are] wherein said bounded random variable has bounded values based on data for just noticable time delay difference from psychoacoustics.